Application of Mobile Mapping and Location Based Services for Dehradun Health Services

K. Ram Mohan Rao*[1], P. Jhorman[2], P.L.N. Raju[2]

[1]National Remote Sensing Centrer, Hyderabad, India

[2]Indian Institute of Remote Sensing, Dehradun, India

*[1]krmrao7@gmail.com; [2] raju@iirs.gov.in

Abstract

Location Based Services (LBS) has emerged as the most powerful application of Mobile GIS. The mobile GIS based applications are becoming an important utility services on traffic information, track of the fleet, emergency services etc. An application of mobile mapping and LBS for Dehradun health services is developed with the integration of remotely sensed satellite data using Geographical Information System (GIS) and web GIS technologies. The spatial data is generated using mobile mapping. The tool addresses the emergency medical services through web GIS technology interlaced with Mobile GIS and provides medical facilities in a GIS environment for various mobile clients to find suitable facility using network analysis. The major contribution of this paper is the integrated approach of mobile GIS, LBS and Information Computing Technologies (ICTs) for health services in Derhadun city.

Keywords

LBS; GIS; ICT

Introduction

There has been a tremendous success of Geoinformation technology. GIS is newly derived from traditional Desktop based systems to mobile phone application technology, called Mobile GIS (David, 2004). The data and the processing tools remain unchanged while the hardware part of the GIS component is becoming slimmer day by day. Currently, the GIS application software tools are customized to a real time applications suitable to hand held GIS applications on a Smartphone and Widnows mobile PDA. The computing power of these handheld mobile devices has also increased with the improvements in the hardware technologies. The developments in the field of computer science influenced the traditional GIS use in all aspects of technology ranging from hardware, database generation, data processing, computing, network technology and data handling to presentation methods (Goodchild, 2011). Most importantly, the advancements in the field of computer science and information computing technologies have influenced directly the growth of geoinformation technology in several aspects. Presently, the world has become what is networked with distributed computing. The client/server architecture allows distributed clients to access data components remotely by using distributed computing techniques such as Open Database Connectivity (ODBC), Remote Procedure Calls (RPC) (Tanenbaum, 2006). These distributed services are connected with various clients to interact with other heterogeneous systems. CORBA and other similar technologies provide interoperability with different systems to interact with (Peng and Tsou, 2003). Most of the internet based applications have become connected less from a connection oriented protocols. Web sensors have been developed to extract the knowledge that can be used to react intelligently and adaptively to changing surroundings. Mobile mapping has become an interesting technology in the context of land surveying. Location Based Services (LBS) has emerged as most powerful application of Mobile GIS (Bhanu, 2011). It has drawn the attention of several applications in the field of Geoinformation science to provide several day to day services on traffic information, trace of the fleet, emergency services etc.

Web GIS has played an important role in disseminating the various types of application data to the public through www protocols. The technology has changed the traditional desktop GIS systems to Web GIS systems to browse the spatial data and make thematic maps as well as perform many operations by the means of spatial query and analysis. Currently, with the advancement of mobile devices on GPS availability and wireless communication, location has become an important parameter in the day to day applications. Lots of applications has been developed for the emergency management and health related

issues with the background of web GIS. These applications mainly deal with the four temporal phases of disaster management namely mitigation, preparedness, response and recovery (David, 2007). Similarly, health services dealing with specific location information benefits several domains of people in case of emergency or need. In this scenario, response time also critical to make the mere decisions. The appropriate use of geospatial services with the blend of mobile GIS technology will really benefit the end users to cope with the emergency. VIPER is a model for Virginia's Web Based Emergency Management System for preparedness for emergencies and responds to disasters (Bobbie, 2009). This model integrates with numerous information systems and links with approximately 250 data feeds. Rao et. al. 2010 developed Spatial Information System for emergency medical services in Dehradun city using Location Based Services (Rao and Laad, 2010). The study mainly focuses on the use of LBS to deal with the emergency services in the city using a web GIS application.

Dehradun, the capital city of Uttarakhand State, India, has approximately 1,698,560 population, according to the 2011 census (Anonymous, 2011). In this study, important medical centers in the city, including hospitals and clinics, along with road infrastructure and ward map of the city are integrated into GIS environment. These hospitals are scattered throughout the city, and it is generally difficult to locate the nearest health centre or more in line health centre depending on the emergency. With this background, a study is carried out to develop an application for Dehradun health services using high-resolution images and GIS data to generate spatial maps facilities with the use of mobile mapping and LBS. The study addresses the following questions to meet the objective of the study.

- How has Mobile GIS become the plotting technology for the development of Location Based Services (LBS)?
- How to create and update Raster and Vector map through mobile mapping technology?
- How to integrate GIS data using Locations Based Services (LBS), Global Position Systems (GPS) and Mobile Mapping for Dehradun health services to support decision making?

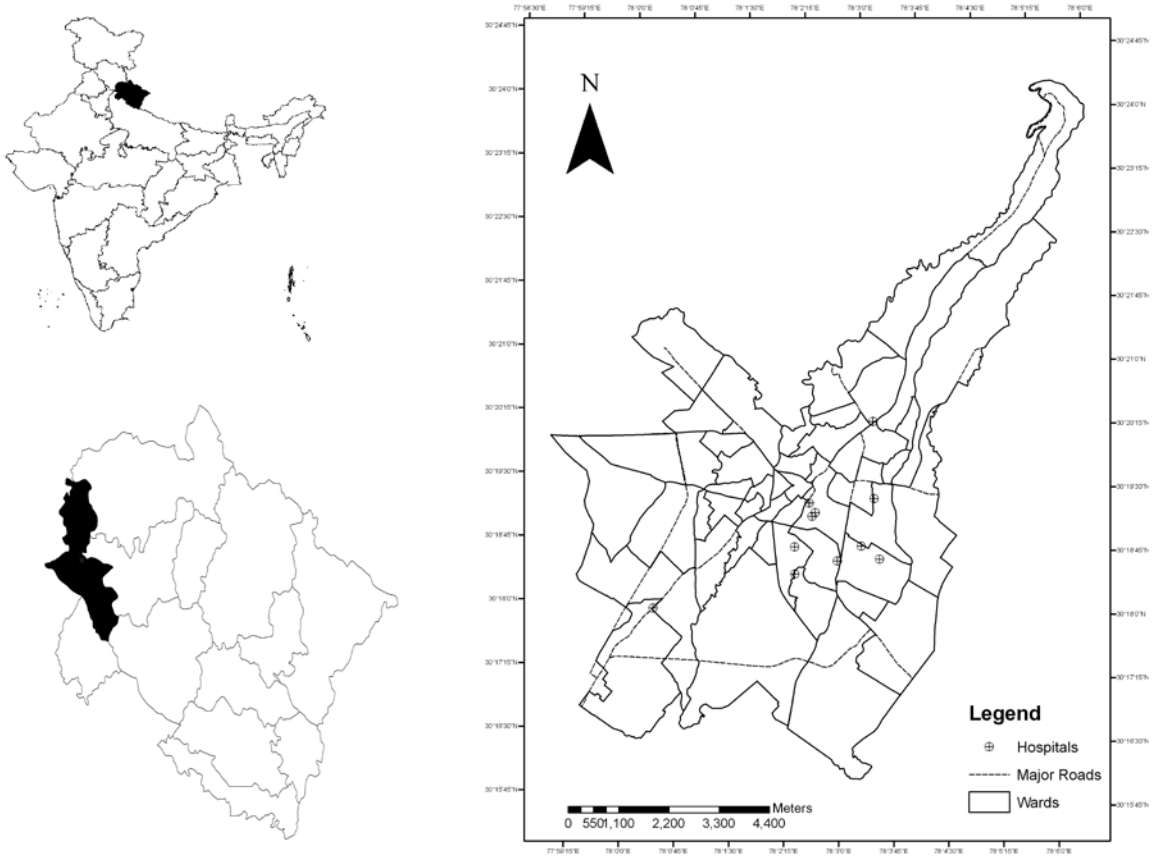

FIG. 1 LOCATION OF THE STUDY AREA

Mobile GIS has been used as the underlined technology to access the hospital information by the means of LBS. The user interface of mobile GIS application is customized in a simple way through application software, so that any user can access the emergency.

Study Area

Dehradun is the capital city of the state of Uttarakhand in the northern part of Indialocated in the Garhwal region, 255 km north of India's capital New Delhi and the National Capital Region. Dehradun consists of 6 tehsils, 6 community development blocks, 17 towns and 764 inhabited villagesas well as 18 uninhabited villages. Located amongst the Shivalik Ranges on the foothills of the Himalayas, the Doon Valley is nestled between two of India's mightiest rivers - the Ganges on the east and the Yamuna on the west. Being a famous tourist destination, Dehradun is known for its picturesque landscape and pleasant climate and its gateway role played in the surrounding region. It is well connected and in close proximity to popular Himalayan tourist destinationsby the convenience to rail and road network to all parts of the country. Fig. 1 shows the location of the study area. Dehradun spatial data is prepared up to the ward level using administrative data. Individual wards are provided with ward name, total population, income, etc.

Methodology

For this study, high resolution images of Google Earth Pro acquired on 13.10.2010 and Ikonos Panchromatic (1 m) and Multispectral (4 m) satellite data acquired on 27.04.2012 are together used for the generation of hospitals, road and ward map of Dehradun city with the use of mobile mapping technologies (Patrick et al, 2007). The Google Earth images used in this work have a resolution of 30 cm per pixel to cover an area approximately 400 x 350 meter and the Ikonos images have a resolution 1 meter panchromatic and 4 meter multispectral that can be combined in a variety of ways to accommodate a wide range of applications requiring high resolution imagery. Google Earth data, Ikonos data and topographic map are projected to the same coordinate systems to overlay all the data required, and the coordinate system adopted is UTM with datum WGS 84 and the zone 44N. The hospitals, road and city wards are organized by using Oracle 10G tool in the form RDBMS table. ArcGIS Server is used for the hosting of the database created using ArcMap. Customisation of the site is carried out by using ArcGIS Server extension by synchronisation, caching and non pooled service. Fig. 2 shows the methodology flow chart for the customization of health services using LBS.

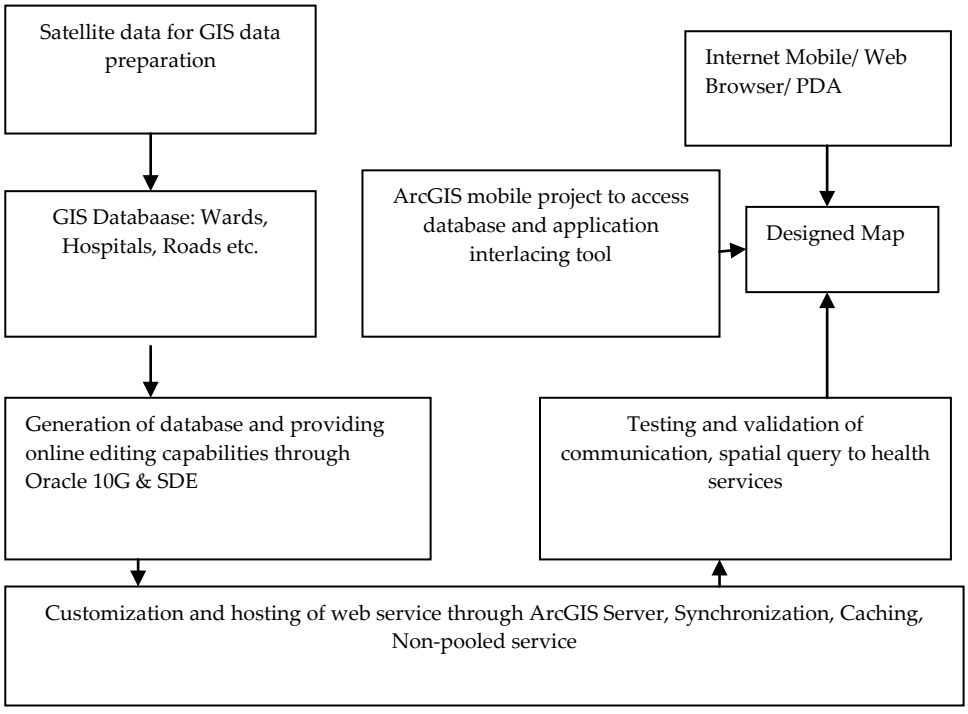

FIG. 2 METHODOLOGY

The application is hosted in an intranet environment to test the hosted capabilities of health services using spatial query. The network extension is utilized to customize the network analysis component in the application tool. Table 1 shows the technologies used in the study.

TABLE 1 TECHNOLOGIES USED THE STUDY

Area	Product/ Technology
GIS data preparation	ESRI's Arc GIS 9.2
Internet GIS	ArcGIS Server 10.0
Web browser	Internet explorer
Programming tools	HTML and Dreamweaver
WebServer	IIS Web server
PDA	Mio A700
Mobile mapping	Windows mobile via ArcGIS Mobile 10.0
Geospatial Database	Oracle 10g

The Oracle spatial is used as the databaseto store the hospital details along with road information. End users of the Oracle databases refer to the server-side memory-structure as the SGA (System Global Area)which typically holds cache information such as data-buffers, SQL commands, and user information. ArcSDE technology manages spatial data in a relational database management system (RDBMS) and enables it to be accessed by ArcGIS mobile clients. Cloud computing is implemented in the health services for the mobile mapping and LBS (ESRI, 2011). The key technology in this study is ArcGIS server extension used to create, manage and distribute the GIService over the intranet to support the desktop, PDA, and mobile mapping applications. A GIS web service is created and hosted in the server application to publish the hospital and road information so that it can be accessed anywhere on the web. Therefore the application is now supporting the cloud computing that can be deployed on a variety of devices and workgroup. Fig. 3 shows the configuration and hosting framework of the GIS Servicewhich is currently interlaced with GIS professionals, mobile clients, and any end user without any expertise in the field of GIS. It supports cloud computing and the same application is available to any end user at any time. The interlaced PDA is shown in figure 4 with the task lists available in the mobile application tool.

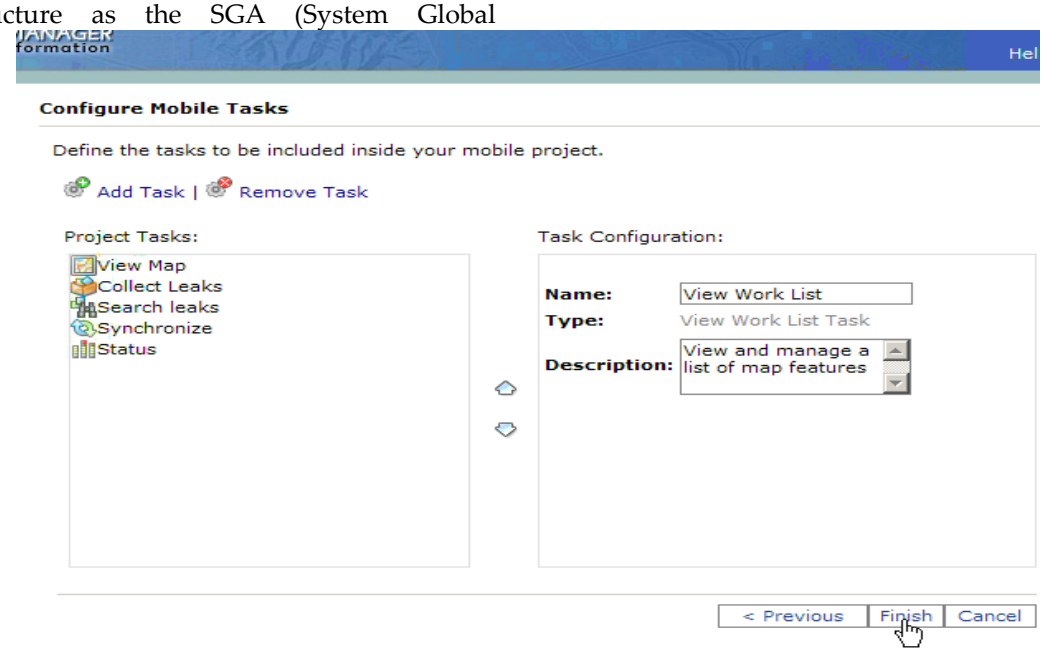

FIG. 3 GIS SERVICE THROUGH ARCGIS SERVER

Results and Discussions

The application making an an illustration on the use of mobile mapping and LBS in health sector to support the data collection and use of GIS data in emergency management, aims to define the integration of GIS data using LBS for health services. The mobile mapping is specifically utilized to generate the vector data such as hospital database, road database etc. with reasonable positional accuracy. The application making an illustration on the use of mobile mapping and LBS in health sector to support the data collection

and use of GIS data in emergency management, aims to define the integration of GIS data using LBS for health services. The mobile mapping is specifically utilized to generate the vector data such as hospital database, road database etc. with reasonable positional accuracy. Fig. 5 shows the database generated using mobile mapping.

FIG. 4 ARCGIS MOILE TOOL INTERLACED WITH SERVER APPLICATION

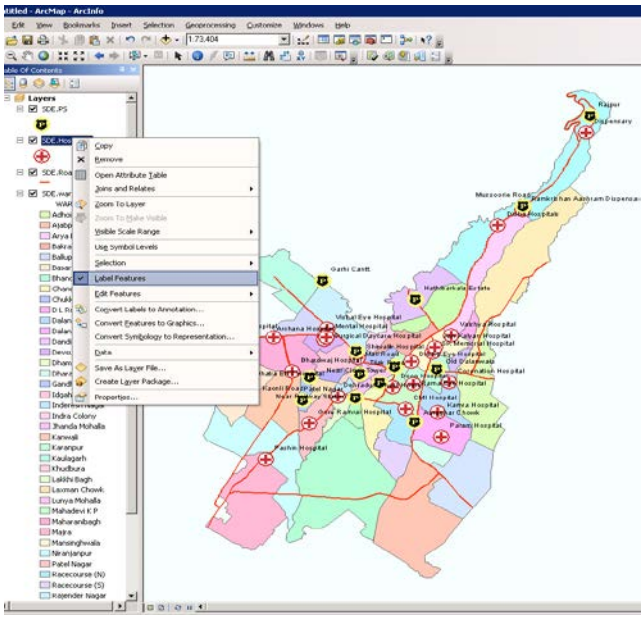

FIG. 5 THE DTA PROJECTED IN DESKTOP GIS TOOL

The point data is created for hospitals and other facilities using mobile mapping device and later these features are provided with attribute data using desktop GIS software tools. Similarly road data is also generated using mobile mapping and desktop GIS technologies. The data sets prepared are then hosted in an ArcGIS server framework with the purpose of making the general masses locate and access the suitable health centre by using the power of network analyst. The entire study has been developed with the ESRI framework and some of the features of the application are:

- View map
- Collect features
- Search
- Work list
- Mange edits
- Browse on map with attribute view
- Utility tool bar
- Delete features
- Powerful spatial analyst with ESRI's network analysis.

The customized web GIS application is powered withArcGIS server then interlaced with ArcGIS mobile interface for effective usage at client level. The clients are now provided with the power of spatial query with view of the results in a map format. Therefore, the end user is provided with all GIS functionality in an easy to use option in a simple format. Nowadays, this mobile interface can be downloaded to any PDA, smart phone, mobile phone or any laptop. Fig. 6 shows the screenshots of application in mobile PDA built in GPS receiver to show the current position along with latitude, longitude and elevation details. Thus the end user can easily query for the required hospital along with network path in a standard map format. The mobile interface also provides rich tool box to view the map by zoom in/out, identity, full extent etc features. The spatial attributes can also be obtained to see the different facilities offered by the individual centre.

FIG. 6. INTERLACING OF HEALTH SERVICES USING MOBILE PDA

Conclusions

Location Based Services and mobile mapping are advanced at very high speed, which has forced the major telecommunication companies to incorporate these services in their applications.

The Computer Aided Design (CAD) and other related map making technologies are almost merged with Geoinformatics discipline. Technologies such as Personal Digital Assistants (PDAs) and 3G (3rd generation) mobile phones: location acquisition (automatic or manual): wireless Internet technology and infrastructure, and GIS solutions for wireless (data and application) play an important role in the emergency services. Integration of these technologies allows the user to facilitate the deployment of emergency services, to easily obtain positioning of data users, customize the information presented to them, thus giving a safe and reliable tool for decision-making in all areas. However, Free and Open Source Software (FOSS) technologies can be used to customize the web applications for health services [12]. UMN MapServer and Geoserver have the great ability to serve the geospatial data sets online and PostGreSQL is a proven open source database tool to handle the geospatial databases.

This study demonstrates the use of GIS technologies for health sector and emergency management which plays a major role in public health services. The application with a capability to deal with any emergency with the help of Location Based Services and GIS functions, takes advantage over the integration of multidisciplinary technologies such as Remote Sensing, GIS, GPS and Mobile GIS. Currently most of the users with mobile phones, smart phones hold GPRS connectivity, therefore this kind of applications will really benefit the public in any emergency situation being coped with.

REFERENCES

Anonymous (2001). Census of India 2001. New Delhi: Registrar General of India.

Bhanu. Location is Personal, Geospatial World. June 2011 Vol 1 Issue 11. PP.31.

Bobbie VIPER: Virginia Deploys Web based emergency management system. ArcNews. Vo. 31. No.3. 2009.

David, "Distributed GIS computing in the internet age". Proc. 12th Int. Conf. on Geoinformatics - Geospatial Information Research: Bridging the Pacific and Atlantic University of Gavle, Sweden, June 7-9. [2004].

David, The Chaging technology of Space and Time. Dynamic and Mobile GIS. Eds Jane Drummond, Roland Billen, Elsa Joao, and David Forrest. CRC Press Taylor and Fransis Group. 2007.

Environmental Systems Research Institute, Cloud computing using ArcGiS. Whitepaper, ESRI Press. 2011.

Goodchild, Formalizing place in geographic information systems. In L.M. Burton, S.P. Kemp, M.-C. Leung, S.A. Matthews, and D.T. Takeuchi, editors, *Communities, Neighborhoods, and Health: Expanding the Boundaries of Place*, pp. 21–35. New York: Springer. 502. [2011].

Patrick ,Ross, IStephan, and Rober, Analyzing point motion with Geographic knowledge discovery techniques Dynamic and Mobile GIS. Eds Jane Drummond, Roland Billen, Elsa Joao, and David Forrest. CRC Press Taylor and Fransis Group. 2007.

Peng and M.H.Tsou, 2003, Internet GIS: Distributed Geographic Information Services for the internet and wireless networks. ISBN 0-471-35923-8m.

Ram Mohan Rao and Laad. 2010. Spatial Information System for Medical services in Dehradun City using Location Based Services. International Journal of Geoinformatics, Vol.6 No.2 June 2010 pp.67-74.

Tanenbaum, Computer Networks, Printece Hall. 2006.

Dr. K. Ram Mohan Rao hold Post Graduate and Doctoral degree in Computer Science. He has research expertise in the fields of Spatial Databases, GIS Customization and dissemination including programminglanguages, Location Based Services, Distributed GIS and Risk modelling .

Rao is working as Scientist in National Remote Sensing Centre, Hyderabad, India. He is a member of Indian Society of Geomatics and Indian Society of Remote Sensing. He has published 21 research papers in peer reviewed natioanl/international journsls. He has also published 1 technical book. His interests include Open source technologies in the field of Geoinformatics.

P. Jhorman holds batcheler degree in sciences from Venezuela. His specialisation is GIS and Cartography. Jhorman is a Post Graduate student of Geoinformatics at Indian Institute of Remote Sensing, India deputed from defense services of Venezuela. His research araas are Cartography, GIS and GPS.

P.L.N. Raju hold M.Tech from Remote Sensing from Anna University, Chennai, India. He has research expertise in the fields of 3D visualisation, Spatial Data Infrastructure and Remote Sensing data polices.

Raju is working as Group Head, Remote Sensing and Geoinformatics group at Indian Institute of Remote Sensing, Dehradun, India. He is also Secretary, Indian Society of Remote Sensing and life member in various Remote Sensing professional bodies. He has published 18 research papers in peer reviewed national/international journals. He has also published chapters in books and full papers in seninar and symposia. His research interests include GPS, Opensource GIS and 3D visualisation.